

52. (New) The method of Claim 51 further comprising recycling an initial spray of fluid.
53. (New) The method of Claim 51 further comprising directing any fluid into the recycling passage that is unable to pass over a wall within the cavity between the cavity outlet and the recycling passage.
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REMARKS

Claims 1-36 are pending in the application. In the Office Action at hand, Claims 11-13 and 30-36 are allowed, Claims 1, 4, 6, 9, 14, 17, 19, 22, 25 and 27 are rejected, and Claims 2, 3, 5, 7, 8, 10, 15, 16, 18, 20, 21, 23, 24, 26, 28 and 29 are objected to. The Applicant points out that the Office Action Summary contains a couple of discrepancies from the Detailed Action with regard to the disposition of the claims.

The Applicant thanks the Examiner for the allowance of Claims 11-13 and 30-36. In addition, the Examiner indicated that Claims 2, 3, 5, 7, 8, 10, 15, 16, 18, 20, 21, 23, 24, 26, 28 and 29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Accordingly, the Applicant has added new Claims 37-53 in which claims 2, 5, 7, 10, 15, 18, 20, 23 and 26 are rewritten into independent form as new Claims 37, 39, 40, 42, 43, 45, 46, 48, 50 and 51 with new Claims 38, 41, 44, 47, 49, 52 and 53 being dependent claims. The Applicant thanks the Examiner for the allowance of new Claims 37-53.

Claims 1, 4, 6, 9, 14, 17, 19, 22, 25 and 27 are rejected under 35 U.S.C. § 102(b) as being unpatentable over Kondo. In response to the § 102(b) rejection, the Applicant respectfully submits that Claims 1, 4, 6, 9, 14, 17, 19, 22, 25 and 27, as amended, are not unpatentable or anticipated by Kondo. Reconsideration is respectfully requested.

The present invention, as recited in Claim 1, as amended, is directed to a fluid sterilization apparatus including a sterilization chamber having a cavity therein. A nozzle is

included for receiving pressurized fluid and directing a spray of the fluid into the cavity. An electron beam generator having an exit window is mounted to the sterilization chamber for directing a beam of electrons through the exit window into the cavity to the sterilization chamber to irradiate the spray of fluid. The nozzle and cavity are configured to direct the spray of fluid substantially parallel and proximate to the exit window.

Claim 9, as amended, further specifies “the spray of the fluid being a thin, flat, film of fluid”. Claim 14, as amended, recites a method of forming a fluid sterilization apparatus that generally parallels Claim 1, as amended, and Claim 22, as amended, recites a method of sterilizing fluid.

Claims 1, 9, 14 and 22 have been amended to recite “the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window.” Claim 9 is further amended to recite “an electron generator having an exit window, the electron beam generator being mounted to the sterilization chamber for directing a beam of electrons through the exit window.” In addition, Claim 30 has been amended to be dependent upon Claim 28. Support for these amendments is found at least in FIGs. 2 and 3, as well as on page 5, lines 7-27, and page 6, lines 14-20, of the Specification as originally filed. No new matter is introduced.

An embodiment of the present invention of Claims 1-10 and 14-30, as amended, is shown in FIG. 2, where the nozzle 28 and cavity 34 of sterilization apparatus 10 are configured to direct the spray 42 of fluid 64 substantially horizontally parallel, proximate and beneath a flat exit window 36 of the electron beam generator 12 within cavity 34 in a manner that is perpendicular to the beam of electrons 38. The cavity 34 is configured to have an upper portion that is relatively horizontal or parallel to the exit window 36 which allows the spray 42 of fluid 64 to pass the exit window 36 in close proximity. The configuration of the nozzle 28 and cavity 34 positions the spray 42 of fluid 64 as close as possible to the exit window 36 while still being spaced therefrom so that the spray 42 of fluid 64 is irradiated by the beam of electrons 38 where the intensity is greatest and the exposure time is longest for maximum sterilization. Such a

configuration provides efficient irradiation and allows lower power electron beam generators to be employed. In one example, the spray 42 of fluid 64 can be about 1/4 inch apart from the exit window 36 as described on page 5, lines 12-13 of the Specification as originally filed. By having the spray 42 of fluid 64 directed proximate or near the exit window 36 rather than against the exit window 36, the life of the exit window 36 can be prolonged. In addition, spacing the spray 42 of fluid 64 from the exit window 36 reduces or eliminates formation of gas vapor bubbles in the fluid. Typically, when fluid is directed against an exit window, heat from the exit window causes gas vapor bubbles to form in the fluid, which is undesirable.

In contrast, Kondo discloses various systems for disinfecting water with an electron beam. FIG. 1 discloses the treatment of vertically falling water with a disinfection section 12 that irradiates the falling water with an electron beam. FIGs. 2-4 depict water that is forced upwardly and at an angle through a nozzle section 25 by means of the weight of the water. The upwardly angled flow of water is irradiated by an electron beam from the scan horn 12a of the disinfecting section 12. The scan horn 12a is connected to an accelerator through a scanning chamber 12b (FIG. 3). FIG. 5 depicts another nozzle 25 configuration. As can be seen, the flow of water in Kondo is not directed into a cavity of a sterilization chamber and is at an angle relative to the scan horn 12a and the electron beam, resulting in lower than maximum irradiation efficiency.

Accordingly, Claims 1, 4, 6, 9, 14, 17, 19, 22, 25 and 27, as amended, are not unpatentable or anticipated in view of Kondo since Kondo does not teach or suggest “a sterilization chamber having a cavity therein”, or “directing a spray of the fluid into the cavity,” or “the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window”, as recited in base Claims 1, 9, 14, as amended, and similarly in base Claim 22, as amended. Therefore, Claims 1, 4, 6, 9, 14, 17, 19, 22, 25 and 27, as amended, are in condition for allowance. Reconsideration is respectfully requested.

With base Claims 1, 9, 14 and 22, as amended, being in condition for allowance, it follows that dependent Claims 2, 3, 5, 7, 8, 10, 15, 16, 18, 20, 21, 23, 24, 26 and 28-30 are also in condition for allowance.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned at (978) 341-0036.

Respectfully submitted,

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MARKED UP VERSION OF AMENDMENTSClaim Amendments Under 37 C.F.R. § 1.121(c)(1)(ii)

1. (Amended) A fluid sterilization apparatus comprising:
 - a sterilization chamber having a cavity therein; [and]
 - a nozzle for receiving pressurized fluid and directing a spray of the fluid into the cavity; and
 - an electron beam generator having an exit window, the electron beam generator being mounted to the sterilization chamber for directing a beam of electrons through the exit window into the cavity to the sterilization chamber to irradiate the spray of fluid, the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window.
9. (Amended) A fluid sterilization apparatus comprising:
 - a sterilization chamber having a cavity therein;
 - a nozzle for receiving pressurized fluid and for directing a spray of the fluid into the cavity, the spray of the fluid being a thin, flat, film of fluid; and
 - an electron beam generator having an exit window, the electron beam generator being mounted to the sterilization chamber for directing a beam of electrons through the exit window into the cavity of the sterilization chamber to irradiate the spray of fluid, the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window.
14. (Amended) A method of forming a fluid sterilization apparatus comprising:
 - providing a sterilization chamber having a cavity therein;
 - forming a nozzle for receiving pressurized fluid and directing a spray of the fluid into the cavity; and

mounting an electron beam generator to the sterilization chamber, the electron beam generator having an exit window and for directing a beam of electrons through the exit window into the cavity of the sterilization chamber to irradiate the spray of fluid, the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window.

22. (Amended) A method of sterilizing fluid comprising:

directing a spray of pressurized fluid from a nozzle assembly into a cavity of a sterilization chamber; and

irradiating the spray of fluid with a beam of electrons from an electron beam generator mounted to the sterilization chamber, the electron beam generator having an exit window through which the beam of electrons is directed, the nozzle and cavity being configured to direct the spray of fluid substantially parallel and proximate to the exit window.

30. (Amended) The method of Claim [31] 28 further comprising directing any fluid into the recycling passage that is unable to pass over a wall within the cavity between the cavity outlet and the recycling passage.